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Vibration suppression of an optical table with inverse disturbance response decoupling

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Abstract

This paper proposes the use of inverse disturbance response decoupling (DRD) for an optical table to suppress vibration in precision machinery. Optical tables are normally adopted in precision engineering to repress two vibration sources: ground disturbances from the environment and load disturbances from machines. The suspension settings for restraining these disturbances are conflicting; therefore, in previous studies, we developed a DRD structure that could independently control the disturbance responses: using soft passive elements to isolate the ground disturbances and improving the load responses by active control. This paper extends these ideas by proposing an inverse DRD structure that uses stiff passive elements to suppress load disturbances and improve ground responses by active control employing robust loop shaping techniques. The designed inverse DRD structure and controllers are implemented and verified by experiments. Based on the results, the proposed inverse DRD structure and robust control are deemed effective in improving the performance of an optical table.